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New approach to solve some problems in undergraduate education of chemical engineering students

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ABSTRACT

The present short paper is an attempt in the direction of understanding the learning problems of undergraduate students. Sample of chemical engineering students was selected to perform a simple exam test. The test was divided into four steps. Closed book - individual student, Closed book - cooperative students, Open book - cooperative students, and Exam completion steps. Questionnaire was carried out to obtain the research results. It was found that a large percentage of the students are not studying carefully, the studying method was shallow and depend only on reading ready printed lectures. The results compared with previous exam results. Current test improved the performance of students. The novelty of present work represented by applying a new teaching method in colleges of engineering in Iraq. This short paper also proved that the methods of teaching not restricted to social and humanity studies.

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1. INTRODUCTION

In educational studies there has been a long standing focus on newly qualified methods of teaching [1-4]. Providing skilled lecturers and modern learning techniques to all students has become a worldwide quest [5-8]. Within this context, classroom discussion is a key topic in the educational sciences. Researchers increasingly agree that learning is most effective when students are actively involved in a dialogic and conversational classroom [9-11]. In recent years, there has also been many new and different approaches in terms of providing support to education [12-15]. Very seldom does research concentrate on *cooperative exam* or *dialogue exam* [16-18]. In the past, most students depended on text books and references in learning to acquire knowledge. The lectures were short in content and the instructors highlighted key points on a blackboard. The students recorded this content and notes and then, with the aid of textbooks, they enlarged their ideas and thoughts. In textbooks, the students can see more examples and exercises; thus, they can expand the short lecture and appropriate it. However, recently, the methods of learning have changed. Instructors, lecturers, teachers and mentors depend on a wide range of tools for learning, such as whiteboards, smartboards, data shows, etc.

They also prepare printed lecture notes in advance to be ready for students. The students do not write anything; they just take these ready-printed lecture notes and read them as they are. The students enclosed and surrounded in these lectures and there is no need for textbooks. Anything outside of these lectures will be foreign and will not be recognized by the students. This is an example of spoon–feeding learning. Student groups can be compared with a nest full of tiny birds, who open their mouths to receive food from their parent. This system is considered in such a way that students do not have to show any creativity; They just simply follow the instructions of their instructors. In other words, they just have to eat

the food that is offered. Most of the paragraphs, examples, problems and exercises are memorable and the student just needs to copy the lecture notes and keep it in their minds until the time of the exam. Within several weeks, they may have forgotten most of the material. The problem of the present research has arose due to years of experience working as academic staff. The students are able to answer and solve problems in the ready-printed lecture notes, but they cannot do the same thing for materials outside these lectures. Thus, the present study aimed to take a sample of students from a chemical engineering class in order to diagnose the problems and lack of learning. The experiment of *cooperative exam* or *dialogue exam* was carried out.

2. RESEARCH METHOD

The test was carried out during the 'Equipment Design' lecture [19], third stage and 'Principles of Chemical Engineering' lecture [20] at the Department of Chemical Engineering, College of Engineering, University of Diyala, Iraq. The number of students in the class were twenty five. Four classrooms were selected (i.e., the total number of sample was 100 students). The exam was appointed previously as a closed book exam. Figure 1 shows the most important steps that were carried out during the test. The following steps were carried out:

a. During step 1, the student performed the test individually using the exam paper only (i.e., closed book, closed notes, closed lectures). Note that all the students were informed that the exam would be carried out according to this step and they did not know anything about the next steps.
b. During step 2, the instructor gave permission for a cooperative exam. Therefore, each student could ask or advise the student beside him/her.
c. During step 3, the instructor gave permission to use the lecture notes or textbooks (open book exam).
d. During step 4, the students completed the answers of the exam.

The exam materials consisted of a theoretical part (definitions and explanations) and calculations (solving design problems). The following rules were put in place for the exam:

a. The period of the exam is one hour.
b. In the theoretical part, plagiarism is forbidden. The student had to re-write the sentences in their own words.
c. Students work in pairs and each pair must deliver one paper at the end of the test.

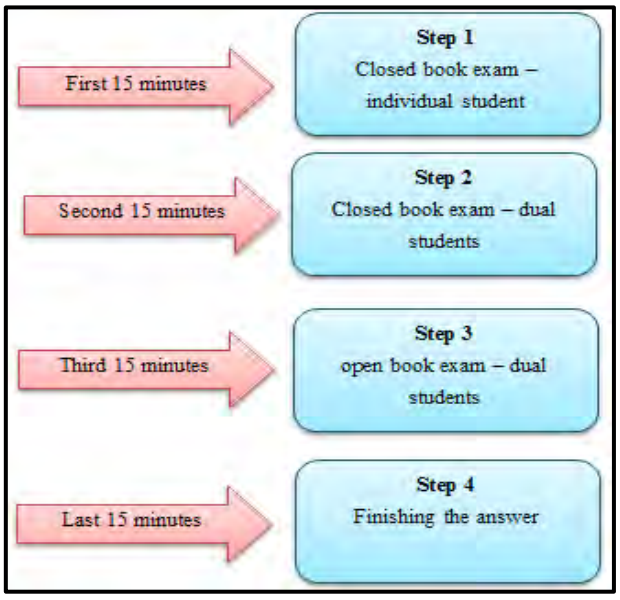

Figure 1. Steps of the cooperative exam

3. RESULTS AND ANALYSIS

3.1. Classroom visual observation and questions construction

The types of questions were different. Some questions were taken from the lectures and others were not. At the beginning of the exam (step 1), the students hardly answered any questions. Visual examination of

papers and students indicate shallow reading and understanding. Some of the students tried to 'peep' and have a look at the paper of the student beside them. Then, permission was given for cooperative exam (step 2). The students were surprised at this untraditional and unconventional way. This step was new for students and changed the boring environment of the exam. Types of subjects, such as equipment design and principles of chemical engineering, contain tedious calculations and empirical equations that can be very difficult to remember. Therefore, the instructor gave permission to use lecture notes or textbooks in order to concentrate on the problem procedure (step 3).

This step led to a focus on the main statement of the problem, excluding the remembering of complex design equations. The interaction of students with each other was observed on one hand, and their interaction with the lecture notes available in front of them was observed on the other. After the end of the exam (step 4), a questionnaire was conducted as shown in Table 1. Each question was selected for a particular purpose. The first question is intended to determine the impact of the provision of information on the performance of students. The second question is aimed at knowing the quality and the way students study. The third question is designed to recognize the effect of cooperation and collective study. The fourth question is designed to see how collective reading affects student privacy. Finally, the fifth question aims to find out about the cooperative study in general, and to test the trust and confidence levels of answering question number four.

Table 1. Results of questionnaire

Item	Questions	Student answers		Percentage agreement
		agree	disagree	
1	Does an open exam provide information that you may lose in a closed exam?	100	0	100%
2	Did you read at home in this way?	34	66	34%
3	Did you read with your colleague in this way?	29	71	29%
4	Would you prefer to repeat the experiment without a colleague?	21	79	21%
5	Would you prefer to repeat the experiment with a colleague?	79	21	79%

3.2. Questionnaire interpretations

Table 1 shows that the students totally agreed with the method of *open exam*. The students who studied in depth and concentrated in this way were few (34%). The percentage of those who studied with their colleagues in a scientific way was also few (29%). The discussion with students shows that most of them do not study in the right way. Furthermore, cooperation between them and the formation of study groups was very few. The percentage of students who preferred to perform the open exam without the help of colleagues were few (21%), while the students who were willing to re-experience the exam in the presence of a colleague was 79%. These results indicate that most of the students prefer team work and studying in groups. This simple test shows that a large percentage of students do not study carefully, their studying method was shallow and depended only on reading ready-printed lecture notes.

The types of exam questions that were developed were equally shared between theoretical and computational problems, provided that the answer to the theoretical problems was written in the student's own words, thus avoiding direct plagiarism from the lectures or textbooks. This method will encourage students to re- read the lecture notes according to their own style and expand their minds. In other words, this technique will help students to summarize the lecture and reformulate them in their own way and avoid the concept of conservation of others. For arithmetic problems, experience has proved that the provision of complex laws and design equations contributed to the improved performance of students. Intensive reading was more effective than reading for hours superficially. Figure 2 shows a comparison between a normal exam that was carried out previously with the results of the students in the cooperative exam. It was observed that there is approximately a 30% improvement in students' performance.

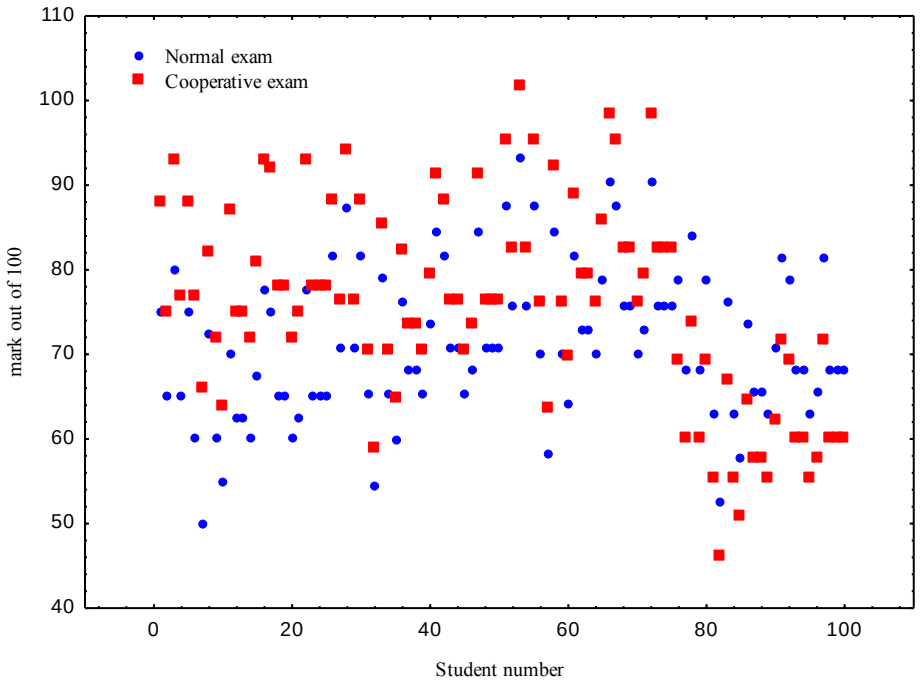

Figure 2. Comparison of normal and cooperative exams.

4. CONCLUSIONS

The following conclusions can be obtained from the present study:

a. The current experiment improved the performance of students.
b. The nature of the exam was closer to mandatory and concentrated on a short period of study. This is better than a superficial study for a long period of time.
c. Many students do not know so far how to read in a proper manner.
d. The open exam test, cooperative environments and questionnaire created a positive and unconventional atmosphere.
e. Adopting the principle of providing some complex mathematical laws and open notes led to a simplification of the conservation.

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